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ABSTRACT

In the face of changing economic conditions and shifts in skill requirements caused by technology, American corporations must integrate learning as an integral part of their functioning. Businesses must implement learning-intensive production, speed up the process of learning how to improve training, and learn how to assess the results of training. Learning-intensive production can be encouraged by extending systematic training to all classes of workers and by rethinking human resources policy to encourage and support learning. The following critical mistakes in traditional education and training should be avoided: (1) skills are taught in progressively more difficult steps; (2) a skill is broken down into separately practiced subskills; (3) learners are treated like blank slates; (4) skills are taught in isolation; (5) knowledge, skills, and their application are separated; and (6) knowledge and skills are taught in a classroom setting unlike settings at work or in real life. Apprenticeship programs may be the most effective method of training, if they include the following components: (1) focus on the conditions of application of the knowledge and skills being learned; (2) take into account the learner's original ideas, stage discrepant or confirming experiences to stimulate questions, and encourage the generation of a range of responses with the opportunity to apply these in various situations; and (3) emphasize learning in context. Assessment should focus on authentic learning outcome measures based on demonstration and performance of competence. (FMW)

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Teachers College, Columbia University
New York, New York

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PREFACE

The National Center on Education and Employment is funded by the Office of Educational Research and Improvement (OERI) of the U.S. Department of Education. The Center is based at Teachers College, Columbia University, in New York City. The RAND Corporation of Santa Monica, California, and Washington, D.C., is a partner with Teachers College in this enterprise.

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Change is a do-or-die reality for American corporations. In case studies of a number of manufacturing and service industries, Thomas Bailey of Columbia University has found frantic innovation and technological change. In the last decade, shifting international markets and sources of comparative advantage, fickle customers, and rapid innovations in products and processes have made one day's winner the next day's loser. This environment of change, as much as the actual characteristics of the new technology, new products, or new trade patterns, has forced fundamental changes in firm strategies. Traditional approaches geared to more stable environments no longer are working.

It is possible that our economy is experiencing a one-time adjustment to a new class of technologies. In this case the problems associated with increased change and uncertainty and the emerging emphasis on the speed of innovation, production, and delivery will subside. However, given the continuing drop in the cost of hardware and software and the speed with which new products are being introduced, it is difficult to believe that the economy is approaching a period of stable technology and markets. In other words, nothing that we see suggests that change will not continue to be a reality for those businesses that survive.

In the face of change and the shifts in skill requirements that change entails, employers theoretically have two options. You can fire current employees and hire new ones, either here or abroad, who can accommodate the new demands. Or you can reconfigure your company so that *learning*—by higher *and* lower skill employees—is an integral and supported feature of your functioning. I submit that you really have no choice—learning is your only feasible, long-term solution, whether we are talking about American employees or those in your overseas operations. As a thoughtful trainer at Motorola said, "Now that the new technologies can be easily bought, the real edge is in how well you use them. We are in a situation that is like the International Race of Champions, where everyone has the same cars and these cars are traded between races. The prize goes to the most skilled driver."

Accordingly, I see three imperatives, given the nature and rate of change. First, create what David Stern's background paper calls learning-intensive production. Second, speed up the process of learning how to improve training. Third, assess the results of your training so that you can improve it.

THE LEARNING ORGANIZATION: MAKING IT HAPPEN

FIRST IMPERATIVE: What corporate assumptions, policies, and practices have to be rethought to create learning-intensive production? Several of your background papers obliquely or directly talk about dimensions of creating a learning organization. Let me highlight a few of these.

- Extend systematic training to all classes of workers. Everyone has to learn, from workers on the shop floor to the CEO. Analyses of Census and Department of Labor data show that corporations invest most of their organized training in managers, professionals, technicians, and salesworkers and little in all other workers.

- Rethink your human resource policies to encourage and support learning. For example:

  - Rethink hiring policies to identify the types and levels of generic competencies that workers must have to be effective learners. For example, Motorola has found that their employees now need higher levels of reading, computational, problem-solving, and communication skills to accommodate training in the company's restructuring operations.

  - Rethink your compensation policies to reward learning and the work habits that contribute to a learning environment, such as coaching the less experienced on the job.

  - Rethink your turnover policies to increase employment stability within the company. We can no longer afford to throw away human resources. The payoffs of greater employment stability are several. Self-evidently, lower turnover increases the length of time over which the company can reap the benefits of its employee training investments.

    A second benefit is the role of stability in encouraging implicit contracts between employers and employees that benefit both. We know that employers invest more in training when turnover is lower. Studies also show that when companies train their employees, these employees' voluntary quit rates drop, *even for employees whose job history prior to the training showed high turnover*. Together, lower turnover and greater training seem to foster a reciprocal, implicit contract between employer and employee to invest mutually in the corporate enterprise.

    A third benefit is that greater employment security reduces the fear that surrounds training and retraining, especially for blue collar employees. Restructuring often renders previously competent employees incompetent. After being told for years that they are capable employees, they suddenly find that the ground rules have changed. This would scare anyone. And as quoted in Stern's paper, Deming observes that "the economic loss from fear is appalling." Both trainers and personnel managers at Motorola stressed how

much effective training requires overcoming fear—of the unknown, of change, of failure.

- Rethink your orientations toward training. Many corporate executives glaze when you mention training. If the company has a regular training group, it is often marginal to the corporation and dramatically downsized at the first signs of economic downturns in the company. In some cases training is imported into the company for specific tasks, on the theory that training is like cooking. That is, you stop when you are done.

  Although your objective is learning, not training per se, powerful training will get you powerful learning. However, you will not get powerful training if you do not conceive of it as a continuous function central to your operations. This means hiring selectively into the training group, giving it adequate resources, protecting these resources as much as you can during downturns, recognizing that employee skills are like a garden that must be constantly tended, and taking seriously the question of whether the training group is doing a good job at creating the skills that your corporate goals require.

- Identify the implicit and explicit hierarchical and status divisions within your company that inhibit learning. For example, traditionally, managers are expected *to know* and workers *to learn from* managers. These arrangements are damaging in two ways. They make it difficult for managers to recognize that they might learn from workers. They make it difficult for workers to take active control over their own learning, an orientation that turns out to be a key to effective learning.

- Examine how you treat failure in your company. Failure is a natural part of learning and of trying to improve performance. Companies that explicitly define failures as learning opportunities encourage employees to learn and thus to run the risks of failures that learning necessarily entails. In his background paper on Japanese manufacturing firms, Robert Cole describes work teams' "presentations" to colleagues and senior management officers. These presentations describe problem-solving methods and solutions to some challenge, such as learning how to operate a new technology efficiently. They are designed to diffuse best practices beyond the immediate work group and to insure that mistakes are not duplicated. Presentations involve a history of the problem-solving activity, including a discussion of the blind alleys pursued and the failures encountered. In other words, learning from failure is a key theme.

SPEED UP THE PROCESS OF FIGURING OUT HOW TO TRAIN EFFECTIVELY

SECOND IMPERATIVE: Speed up the process of figuring out how to train effectively. Corporate training varies a great deal in the extent to which it embodies what we know about how individuals learn most effectively. The process of moving from less to more effective training is often hit-or-miss and therefore lengthy and costly for companies. We now have a powerful and pioneering

research base that can help to rationalize and shorten the training improvement process—the cognitive sciences. If you have never heard of this knowledge base, you are in good company. I think even the cognitive scientists in this audience would agree that many of their tribe sit in a closet and talk only to each other. One of the major challenges for this field is working with companies to understand the implications of this research base for real-world training. At the same time, this research deeply affects training of all kinds, including corporate training. It challenges ***what*** we teach, ***to whom*** we teach it, ***when*** we teach it during the worker's learning, and ***how*** we teach it.

At the heart of this research is the presumption that intelligence and expertise are built out of interaction with the environment, not in isolation from it. It thus challenges traditional and treasured distinctions, such as those between:

- head and hand
- classroom and informal on-the-job training
- knowing and doing, and
- abstract and applied.

Although the implications of this work have been used primarily to critique elementary and secondary education, the nation's educational and training systems do not differ particularly in their pedagogic strategies, whatever the rhetoric. All of these systems have very limited success because they have similar pedagogic problems. Americans share the common experience of elementary and secondary schooling. This shared experience pervasively, implicitly, and powerfully frames our ideas and models of what learning environments should look like, including corporate learning environments. Thus, the pedagogic problems of our elementary and secondary schools get reproduced even in corporate training programs.

Mistakes in Training

Let's start with six mistakes that we persistently make in education and training.

First: It is not true that skills are like building blocks, that people must learn "the basics" or "first things first" before they can learn specific technical or problem-solving skills. However, most work-based training operates on this assumption. For example, in training production workers to handle a new production process, we often assume that they need to learn facts before they can begin

to deal with the more complex problems surrounding the process. However, *the human being*—even the small child—*is quintessentially a sense-making, problem-solving animal.* By not involving the worker's sense-making inclinations in early learning, we not only miss opportunities to begin refining his or her problem-solving skills in the domain that we are trying to teach, but create barriers to learning itself.

Second: Often a skill is decomposed into subskills, and each subskill is practiced separately. But it is seldom true that learning each of the subskills separately produces competence in the skill itself.

Third: The common image of the learner is that of the blank slate. However, the more appropriate image of learning is replacing what is already on the slate, not writing on a clean one. Workers bring their own conceptions to the learning situation. For example, we find that individuals have their own conceptions of natural phenomena, such as light, heat, and temperature, or electricity. These ideas are personal—constructed out of their interpretations of naive experience, coherent in their own terms, and resistant to change through traditional training.

Traditional curriculum design usually is based on a conceptual analysis of the subject matter that ignores what is already in the learner's head, with the result that employees can play back memorized canonical knowledge and conceptions but return to their own ideas when confronted with unfamiliar questions or non-routine problems. For example, college physics students can solve "book" problems in Newtonian mechanics by rote application of formulae. However, when faced with an unfamiliar problem to which their formal instruction is in fact relevant, they revert to naive pre-Newtonian explanations of common physical situations.

Fourth: Skills are taught in isolation, with too little experience with their application or of how they are used in combination. Studies reveal a surprising lack of transfer of theoretical principles, processes, or skills learned in classes to practice. For example, studies show that extensive training in electronics and troubleshooting theories provide very little knowledge and fewer skills directly applicable to performing electronic troubleshooting.

Fifth: Separating "learning to know" and "learning to do" is dysfunctional. Corporate training tends to focus on "learning to know" for executives and on "learning to do" for blue-collar workers. However, "know thats," "know hows," and their application are inseparable; there is no effective understanding or learning of one without the other two.

Sixth: Too often knowledge and skills are taught in settings that do not reproduce the settings in which the work must be performed. This teaching out of context impedes the transfer of training to settings outside the training context.

For example, corporate training is often individualistic. However, work increasingly occurs within the context of teams, where what one person is able to do depends fundamentally on what others do and in which "successful" functioning depends upon the mesh of several individuals' mental and physical performances. This contrast argues for much more team and cooperative learning in corporate training programs.

Similarly, work is intimately involved with tools and resources of all kinds—from production technologies to computerized data bases to access to more experienced co-workers. The criteria for competence include the expert use of tools and resources. Too often training situations do not include the full array of resources that workers are expected to be able to use in their work.

Modern Apprenticeship

If traditional corporate training is not particularly effective, what is? The streams of cognitive research come together in a renewed interest in learning through apprenticeship—not, however, in traditional craft apprenticeships. Traditional apprenticeship never worked well for higher skill occupations and today works poorly even for lower skill ones. Traditional apprenticeship involves little explicit teaching and depends primarily on learning by observation. Many jobs today do not allow a novice, merely through observation, to acquire awareness of what the expert does or why. Individual and group tasks have become opaque; the technology, complex, hidden, or automated. Thus, little is to be seen, understood, or mastered by simply being on the scene, especially in the absence of explanatory and explicitly taught context for why various operations take place.

Cognitive science analyses of competence have led to a number of successful education and training programs that constitute modern apprenticeships. These programs have several characteristics in common. For example:

- **First:** they do not just teach knowledge and procedures; they also focus on the conditions of application of the knowledge and skills being learned.
- **Second:** instead of constructing curriculum top-down by encoding the knowledge of experts in suitably simplified materials, instruction takes into account the learner's original ideas, stages discrepant or confirming experiences to stimulate questions, and encourages the generation of a range of responses with the opportunity to apply these in various situations.
- **Third:** they recognize the importance of situated learning and learning in context, such as the use of the physical environment and the tools it provides to represent problems and develop solutions or the cooperative construction of knowledge among groups of workers doing a common task.

ASSESS YOUR TRAINING

THIRD IMPERATIVE: Assess your training. When I use the term "assessment," I am talking only about the learning outcomes of workers and work teams, not more complicated evaluations of the training system, such as return-on-investment analyses. Learning is the first bottom line of training, training and all of the infrastructure required to deliver it are only a means to that end.

Authenticity is the first issue in designing measures of learning outcomes. By "authentic" I mean that the outcomes measured should mirror the company's goals for competent performance. This sounds obvious. However, what is measured—and how this is done—can get badly out of whack with what everyone says they want from the training system. For example, we want our schools to develop the problem-solving skills that we all know will be needed in the workplace. However, we then use multiple choice tests to assess learning outcomes. Multiple choice tests preclude displays of problem-solving and other metacognitive skills, implicitly presuming that "competence" is the ability to retrieve the "right" facts from a warehouse of facts. They thus encourage routine drill in bits and pieces and militate against the development of problem-solving skills, which have more to do with the intelligent use of judgment than with "right" answers. Since multiple choice tests are also only paper and pencil tests, we also cannot see if students can use the other tools and resources in task performance that are routinely available and critical to performance outside of school.

In designing authentic outcome measures, key ideas are "demonstration" or "performance". Good models here are how we judge artistic performance—for example, the piano or violin recital, or athletic performances in Olympic tryouts, or demonstrations of competence that boy scouts and girl scouts go through to win merit badges. These models are clearly appropriate for assessing workers' and work teams' *mastery* of tasks, in that the competencies to be displayed are known and have been practiced. However, these models can also be used to assess how workers or work teams handle ***new or previously unencountered situations.*** In this case judges look not for mastery of the task, but at how well individuals frame the unfamiliar problem and identify and organize resources—whether documents, experts, or other tools—to help them solve it.

Authentic outcome measures perform three important functions. First, they hold training operations *accountable* for performance. Part of taking training seriously is taking its effectiveness seriously. Measuring learning outcomes is part of that process and gives training credibility within the larger corporation.

Second, outcome measures become engines for dynamic learning within the training group itself. When measurement results affect the reputation of the training group and, in competency-based compensation systems, the salaries of workers, studies show that what and how we measure determine what gets taught; what we do not measure does not get taught. Thus, outcome measures operate like feedback systems for the training group.

Finally, outcome measures are a vehicle for communicating among the groups in the company that have to work together to identify skill requirements and restructure the competencies of the company's labor force. In other words, they work as *signals* that coordinate the decisions of multiple parties within the company.

Outcome measures can only work as signals if they are transparently understandable by everyone who needs the information that they carry, from workers to top executives. Only then can all parties with an interest in these measures "see," use, and debate their results. If the outcomes measured and their results carry no intuitive meaning to anyone outside of the training and measurement world, they are opaque and useless for communication purposes. For example, reporting that 20 production workers achieved an eighth grade reading level tells those outside of the training

and testing world precisely nothing. The issue is how well these workers can perform those tasks that may require this reading level but that have broad meaning to people across the company.

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